

The

MONITOR

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Future

Present

Depot and GOCO Technologies

Past



Weapon System P2 Champions

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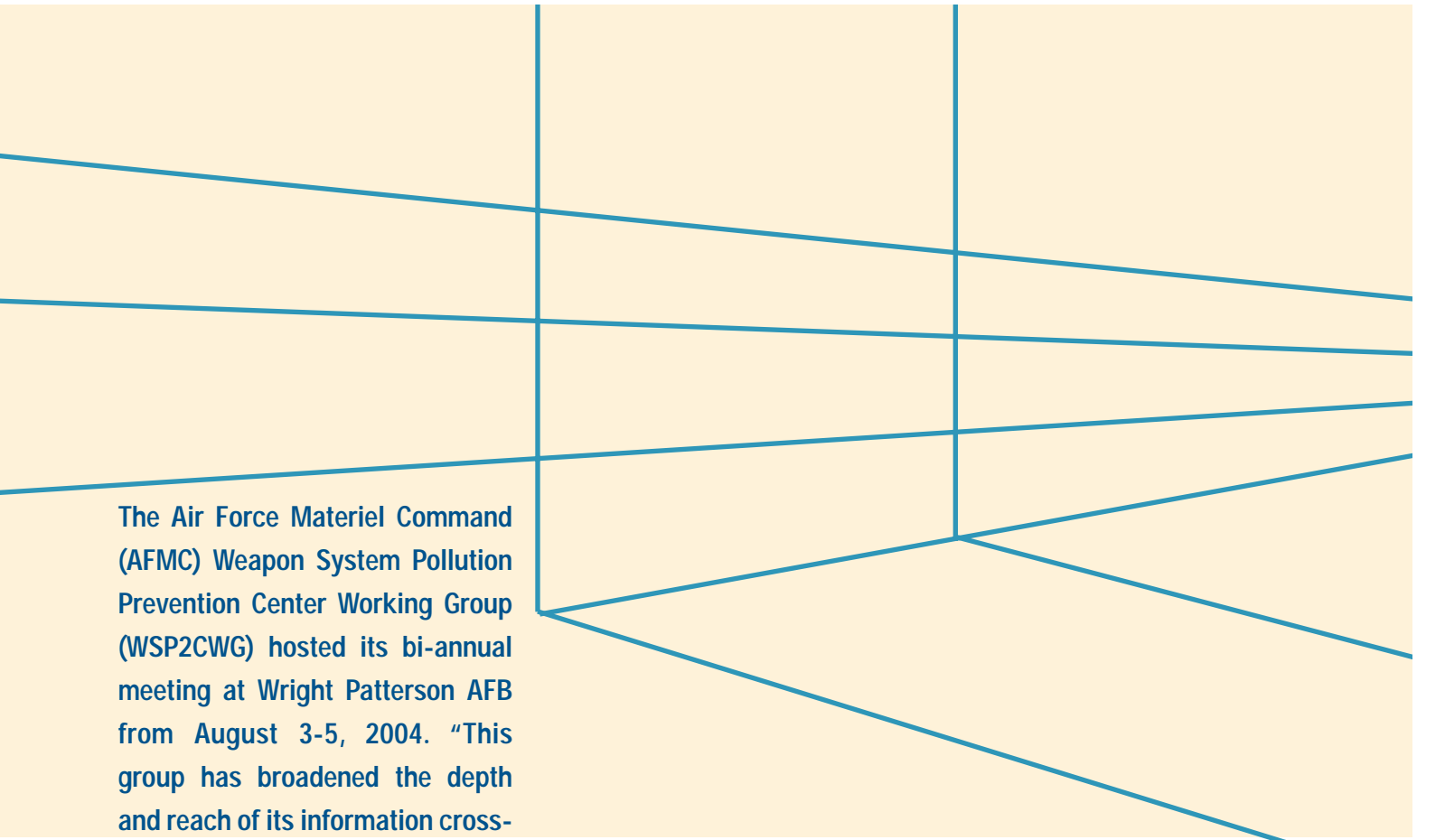
Depot and GOCO Technologies

The **MONITOR** is a quarterly publication of the Headquarters Air Force Materiel Command (AFMC) Pollution Prevention Integrated Product Team (P2IPT) dedicated to integrating environment, safety, and health related issues across the entire life cycle of Air Force Weapon Systems. AFMC does not endorse the products featured in this magazine. The views and opinions expressed in this publication are not necessarily those of AFMC.

All inquiries or submissions to the **MONITOR** may be addressed to the Program Manager, **Mr. Frank Brown**.

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The Air Force Materiel Command (AFMC) Weapon System Pollution Prevention Center Working Group (WSP2CWG) hosted its bi-annual meeting at Wright Patterson AFB from August 3-5, 2004. "This group has broadened the depth and reach of its information cross-

AFMC Weapon System Pollution Prevention Center Working Group Update

feed and joint solutions initiatives since we last hosted a meeting at Wright Patterson AFB. The success of this group has benefited the Air Force and in the future, I believe, can greatly aid the strategic initiatives we are pursuing under depot transformation," states Debbie Meredith, AFMC WSP2CWG Chair.

During the meeting, cross-feed briefings on re-organization and program updates were presented by Air Force Materiel Command, Directorate of Logistics & Sustainment (AFMC/LG) and AFMC, Directorate of Mission Support

(AFMC/MS). Additional briefings were given by Air Force Research Laboratory (AFRL), Aeronautical Systems Center (ASC), Air Force Institute of Occupational Health (AFIOH), Human System Wing (HSW), and by joint service programs, such as the Joint Group on Pollution Prevention (JG-PP), the Propulsion Environmental Working Group (PEWG), the National Defense Center for Environmental Excellence (NDCEE), and the Strategic Environmental Research and Development Program (SERDP). The meeting concluded with a tour of the AFRL facility at Wright Patterson AFB.

Tom Spitler, HQ AFMC/LGPE, and Ed Finke, HQ AFMC/MSEVQ, summarized the Command's re-organi-

zation, with discussion of how these changes will impact the roles and responsibilities of the HQ AFMC Pollution Prevention Integrated Product Team (HQ AFMC P2IPT). Similarly, ASC/ENVV summarized their anticipated re-organization when the Center moves under a wing structure, in response to Transformation.

Program update briefings given by the Command representatives, included the following:

- Pollution Prevention Program Update, presented by Ed Finke, AFMC/MSEVQ.
- Depot Maintenance Transformation (DMT) Trailblazer Update, presented by Greg Treadwell, AFMC/LGD.

- Maintenance Environmental, Safety and Occupational Health (ESOH) Program, presented by Linda Willis, AFMC/LGPE (see related article on [page 6](#)).

Tom Naguy, AFRL/MLSC and Frank Ivancic, ASC/ENVV summarized their organizations' technology transition successes. Specific briefings related to Joint Service initiatives included the following:

- JG-PP Program (www.jgpp.com) Update, presented by Patricia Jordan, AFMC/LGPE.
- NDCEE (www.ndcee.ctc.com) Update, presented by Dave Schario, Concurrent Technologies Corporation.
- PEWG (www.pewg.com) Update, presented by Mary Swinford, ASC/LP.
- Update on SERDP's (www.serdp.org) recent Painting/Depainting Workshop, presented by Tom Naguy, AFRL/MLSC.

Adrian Salinas, 311 HSW/XRPA summarized the recent improvements to the Environmental Development Planning (EDP) Database (<https://xre22.brooks.af.mil>) and Don Knotts, AFMC/LGPE briefed the current effort to quantify the environmental data

for the AFMC needs listed in the EDP Database. Frank Brown, ASC/ENVV provided an overview of the Solutions Database and discussed further efforts to collect data on new projects, using Knowledge Now.

Susan Misra, AFMC/LGPE, briefed the Depot Technology Modernization Program (DTMP), which is the single venue for depot technology data call (see related article on [page 8](#)). Updates were also given on a host of technologies, including the following:

- Environmentally Friendly Non Destructive Inspection (NDI) for Corrosion Inspection through Coatings, presented by John Speers, AFRL/MLSC (see related article on [page 25](#)).
- High Velocity Oxygen Fuel (HVOF) Update, presented by Joe Kolek (AFRL/MLSC).
- Ultraviolet Curable Coatings, presented by Neese Orbey, Foster-Miller, Inc.
- Plural Paint, presented by Chuck Valley and Jim Tankersley (ASC/ENVV).
- Environmentally Friendly Coatings, presented by Mary Wyderski, ASC/YPVE (see related article on [page 20](#)).
- Status Update on the Command Laser Project Field

Demonstration, presented by Tom Naguy, AFRL/MLSC.

- Ergonomics of the Laser, presented by Major Linda Schemm, AFIOH/RSHI.

"This group

has broadened the depth and reach of its information cross-feed and joint solutions initiatives..."

Briefing packages related to this meeting will be available for download at the CWG website. For additional information, please contact Ms. Lori Sargeant at lori.sargeant@wpafb.af.mil.

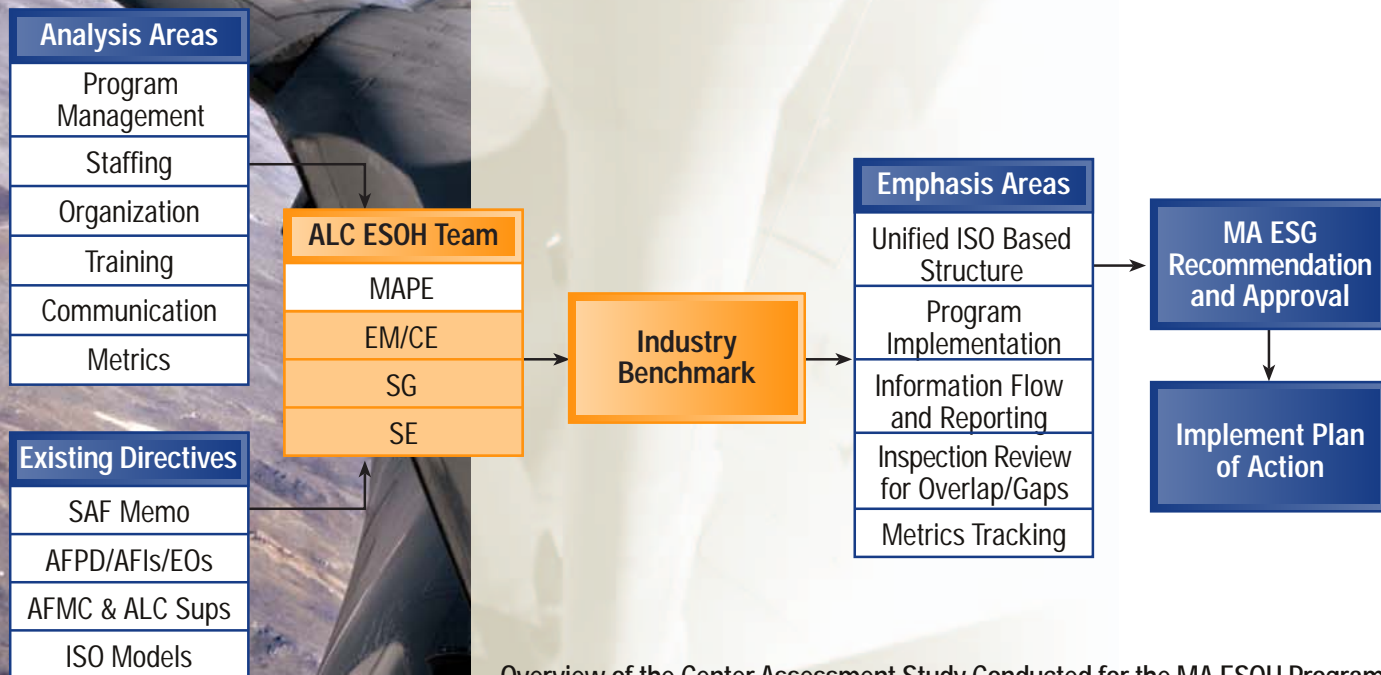
The Maintenance (MA) Environmental Safety and Occupational Health (ESOH) Program was formed in 2003 at the Air Logistics Centers (ALCs) to satisfy ESOH shortfalls that exist within the MA directorates. The organization was formed at the MAPE level reporting to Process Improvement and Quality Assurance Division (MAP).

The program shows that the Maintenance Directorate is committed to ESOH compliance and prevention for its workforce and community. Headquarters Air Force Materiel Command Directorate of Logistics and Sustainment, Depot Programs Division (HQ AFMC/LGP) is currently providing programmatic support to move the MA ESOH Program towards the desired end

AFMC Conducts a Center Assessment to Standardize the MA ESOH Program

state. A Center Assessment Study, as outlined in the figure on [page 7](#), has been a central component to this effort.

This initiative is of special interest to the MA-Executive Steering Group (ESG), who is looking for an execution plan and management system for the MA ESOH Program to succeed. HQ AFMC/LGPE is leading a MA ESOH Working Group and is presently using the Air Force Knowledge Now ALC MA ESOH Community of Practice (CoP) to facilitate this process. The working group is comprised of subject mat-



Overview of the Center Assessment Study Conducted for the MA ESOH Program

ter experts who are knowledgeable and engaged in the daily activities of the MA ESOH Program. The working group consists of core members representing HQ AFMC, ALC MA Staff, and ALC functional ESOH stakeholders. Core activities for MA ESOH Programs are being identified under their guidance as well as development of Standard Procedures for Weapon System Pollution Prevention (WSP2) and other compliance and prevention programs that interact with ALC Environmental (EM), Safety (SE) and Occupational Health (SG) functional units.

In May 2004, HQ AFMC conducted ALC site visits to baseline the current processes and to identify and develop standard processes. In June 2004, HQ AFMC benchmarked the Rolls Royce, Indianapolis, IN and Alcoa Corporate Center, Pittsburgh, PA facilities to capture the lessons

learned from industry. The MA ESG is reviewing the results and recommendations of this assessment and a phased implementation is planned.

The MA-ESG approved recommendations will be executed to the desired end-state with ongoing continuous improvement. Joint ESOH action items will be resolved through the MA ESOH Working Group in weekly telecommunications, video-teleconferences, and face-to-face meetings. Status update and decision meetings are planned with MA ESOH representatives and ALC/HQ AFMC ESOH functionals during the first phase of implementation.

The AFMC/LG Program Managers for the MA ESOH Programs are Ms. Linda Willis, and Mr. Chris Bucher, HQ AFMC/LGPE. Mr. John Joyce and Ms. JoAnn Morley, Anteon Corporation provide contract support for this effort.

In September 2003, Headquarters Air Force Materiel Command, Directorate of Logistics and Sustainment (HQ AFMC/LG), implemented the Depot Technology Modernization Program (DTMP) as the single venue for identifying depot technology needs across the Future Years Defense Plan, including Science and Technology (S&T) and transition (demonstration/validation) requirements.

The DTMP:

- Links requirements to major Air Force Planning Documents, such as the AF Depot Maintenance Master Plan (DMMP), the AF Long Term Depot Maintenance Strategy (LTDMS), and the AF Integrated Capability Review & Risk Assessment (AF I-CRRA) list.
- Links the main organizations involved in AFMC depot technology insertion, including HQ AFMC, Air Force Research Laboratory (AFRL), Aeronautical Systems Center (ASC), Air Logistics Centers (ALCs), and the Aerospace Maintenance and Regeneration Center (AMARC).

Depot Technology Modernization Program Update

- Provides a single Command-validated and prioritized list of depot maintenance technology requirements that can be easily tracked.

Specific requirements for each depot are submitted through the Points of Contact (POCs) listed on [page 9](#). The Centers each submit a prioritized list of requirements, which are then ranked and consolidated into a single AFMC prioritized list. Command representatives and personnel from the Centers' maintenance, engineering, and planning functional areas are all involved in the prioritization process. This group categorizes the requirements into S&T or Transition and then prioritizes them in accordance with DTMP guidance. The Maintenance Executive Steering Group (MA ESG) and Center Commanders approve the final AFMC prioritized lists. In certain instances when a submitted requirement is determined to have a commercial-off-the-shelf (COTS) solution, it is returned to the Center for resolution within established COTS funding programs, such as the HQ AFMC Capital Purchases Program (CPP).

The S&T and Transition prioritized lists are submitted to the AFMC Technical Advisory Group (TAG), and the Aeronautical Systems Center, Aging Aircraft (ASC/AA), respectively, to compete for funding. In summary, the DTMP generates MAJCOM validated and approved lists of technology requirements that are incorporated into the AF Strategic Planning Processes.

The FY07 S&T and Transition prioritized lists are presented on [page 9](#). The data call for the FY08 requirements will be sent out in November 2004 and are due in January 2005. AMARC is a new participant to the FY 08 data call. If you would like to participate in the FY08 data call, please contact your local representative or HQ AFMC/LGPE for additional information.

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Priority**S&T List****Transition List**

- | | | |
|----|--|---|
| 1 | Wing Center Bolt Hole Inspection (OO-ALC) | Wet Blast Media Paint Stripping (WR-ALC) |
| 2 | C-130 Damage Detecting Using Ultrasonic Technology (WR-ALC) | C-5, C-17, C-130, & B-1 Sized Aircraft Under Fuselage Mobile Blast (WR-ALC) |
| 3 | Laser Shearography Inspection System (OO-ALC) | C-5 & C-17 Sized Aircraft Under Wing Mobile Blast (WR-ALC) |
| 4 | F-15 and All Aircraft NDI Modernization (WR-ALC) | MIDS Hardware Screening (WR-ALC) |
| 5 | NDI of Parent Material Around Encapsulated Bushings | Wiring Characterization Tester (OO-ALC) |
| 6 | MAUS Inspection for ID of Fuel Leaks (OC-ALC) | F-15 Robotic Paint (WR-ALC) |
| 7 | NDI Method for Predicting Radar Beam Divergence (OC-ALC) | C-15, C-17, & C-130 Sized Aircraft Tail Media Blast Depaint Augmentation (WR-ALC) |
| 8 | Replacement of NDI for Tap Test (OC-ALC) | F-15 & Fighter Automated Jacking & Leveling System (WR-ALC) |
| 9 | E-3 Radome Radio Frequency Performance Verification (OC-ALC) | EWASIF Simulation/Testing Transformation (WR-ALC) |
| 10 | Alternative Fire Suppressant for Hush Houses (WR-ALC) | Wheat Starch Paint Stripping Media (WR-ALC) |
| 11 | Protective Maskant for C-130 Prop Blade Thrust Rings (WR-ALC) | Ultra-Violet Cured Coatings for Use on Radomes (WR-ALC) |
| 12 | Environmental Forensics (OC-ALC) | Volatile Organic Compound Sensors for Contaminated Air Dischargers (OC-ALC) |
| 13 | Sampling & Analysis (OC-ALC) | Contained Burn System (OO-ALC) |
| 14 | Alternatives to Aqueous Film Forming Foam (OC-ALC) | |
| 15 | Effects of Tinker Groundwater Characteristics on Stainless Steel Monitoring Wells (OC-ALC) | |

The Depot Maintenance Activity Group's (DMAG's) two main objectives are to: 1) provide depot repair capability for fielded and emerging weapon systems; and 2) ensure rapid response to user requirements that are driven by contingency operations.

The Capital Purchase Program (CPP) is a key component of the DMAG and is used to justify budget inputs from validated and prioritized user requirements. However, the extensive documentation required to justify the CPP budget has made the process cumber-

munities. Additionally, CPP Managers, engineers, cost analysts, and logisticians from all three depots and the Aerospace Maintenance and Regeneration Center (AMARC) attended the three-day meeting. The lean event was facilitated by Simpler Consulting, and supported by International Trade Bridge (ITB) Inc.

"Over the last year, we have been applying lean concepts across every aspect of the CPP and have had many successes," states Mr. Frank Berger, AFMC CPP Manager. "In particular, separate Value Stream Analyses (VSA) have reduced non-value added steps in the CPP process by 43% at AMARC,

During the lean event, each center mapped the EA process and developed the Supplier, Input, Process, Output, and Customer (SIPOC) flow to assist in creating a preferred future state for conducting EAs. First, the data needed by the requirements owner, the cost analyst, and the budgeter was determined. Then, a flow of the inputs and outputs of data requirements and generation between these three communities was developed to define a standard process.

At the conclusion of the lean event, the installations and Command participants said that they had gained a better understanding the EA process at the different installations. They

AFMC Hosts a Lean Event as Part of Re-Engineering the Capital Purchase Program

some. The re-engineering of the CPP process is a priority for Air Force Materiel Command (AFMC) and is being managed by HQ AFMC Directorate of Logistics and Sustainment, Modernization and Environmental Branch (HQ AFMC/LGPE).

In August 2004, HQ AFMC/LGPE hosted a CPP Re-Engineering cross-feed meeting at Wright-Patterson AFB, which included a lean event on the Economic Analysis (EA) process. Command participants included members from the financial management, transformation, and logistics com-

20% at Robins, 73% at Hill, and 86% at Ogden. The lessons learned from the current re-engineering effort will be incorporated into the rewrite of AFMCI 21-109, which provides the Command's Guidance on the CPP."

During the meeting at Wright-Patterson AFB, all the installations discussed the benefits of the VSA. Mr. Rod Fink, AMARC Financial Analyst stated, "The AMARC Commander strongly supports the VSA findings and has tasked a team to implement them."

stated that "leaning the process collectively" and developing common definitions will help in fostering future communication between the installations and Command. The participants hoped that Air Staff would also consider conducting a lean event on key portions of the CPP to ensure the overall process becomes leaner and more agile.

The group has established a Community of Practice, which can be accessed from the Air Force Knowledge Now (AFKN) web page at: <https://afkm.wpafb.af.mil/ASPs/CoP/EntryCoP.asp?Filter=OO-LG-CP-PO>.



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System, as the name implies, is a high-powered, CO2 pulsed laser that delivers a precisely focused beam of far -infrared energy on a spot on the item to be stripped. The laser is fed a mix of three gases that are electrically excited by a precisely timed burst of X-ray energy and a very short duration high voltage pulse, that “pumps” the laser and initiates the lasing action. A dedicated controller

- **Beam Delivery System** – After development of the beam by the laser, it is focused and directed toward the target via a set of specially designed and coated mirrors inside an enclosed safety housing to the Beam Director Arm-the transition point of the beam to the target. The beam emerges as a focused 2-cm2 spot on the target that heats up the surface (paint in this case) to about

Lessons Learned from the LADS Facility at OO-ALC

The Laser Automated Decoating System (LADS) at Ogden Air Logistics Center (OO-ALC) is a pollution prevention success story. Since May 1995, when the technology was transitioned into production, LADS has saved over \$18M in hazardous waste costs. Today, the waste stream from this process is about a cupful of non-hazardous waste. The LADS facility is also a maintenance and support success story. Since 2001, OO-ALC has been upgrading the LADS subsystems with commercial off-the shelf (COTS) components. Today, the LADS facility has 95% COTS and only 5% unique components. The production capable time for the LADS is greater than 80%.

The technology consists of the following five major systems with an integrating software system:

- **Laser Generation System** – The heart of the Laser Generation

This article was written in collaboration with Mr. Lonnie Sutton, OO-ALC (UDRI DESP Team—Aerospace Engineering Spectrum).

linked via PC-based software controls the actions of the laser and the timing of the process as well as controlling and monitoring parameters for personnel and equipment safety.

2300 degrees F. This turns a small layer of the paint to liquid and boils off or “ablates” the paint. Fine soot and gases are the remnants of this process and are drawn back through the beam to be collected later in the waste collection system.

- **Target Motion Control System** – Were the beam to continually strike the target in the same spot without managing the amount of time allowed, the target would eventually be burned through. By rotating the target through the stationary beam and advancing the target forward, the duration the beam is on target or “dwell time” can be used to control the amount of paint and substrate heat build up that occurs. This is the function of the Target Motion



Control System, which follows a set of predefined geometric profiles for each type of target item being stripped. These are defined and stored in the Motion Controllers memory as “point files”, and are used to control the stripping process.

- **Waste Collection System** – As the soot and gases from the stripping process are developed, they are drawn off by a Waste Collection System consisting of a baffle prefilter that collects about 30% of the soot, before being directed to a dust collector with two stages of filtration. First, a 4” pleated filter collects the remaining soot and is replaced after about every 3 passes. There then follows a double cylindrical HEPA filter that scrubs the remaining smoke prior to the air stream exiting the roof of the building.
- **Central Control System** – A computer based control system gives the operator input and control over the other four sub-system, including setup of the target object, laser control, fault indications and diagnosis and emergency control.

The entire system consists of eighteen sub-subsystems whose functions are greatly interconnected with each other.

Laser decoating has many Environmental, Safety, and Occupational Health (ESOH) and opera-

tional benefits, which include the following:

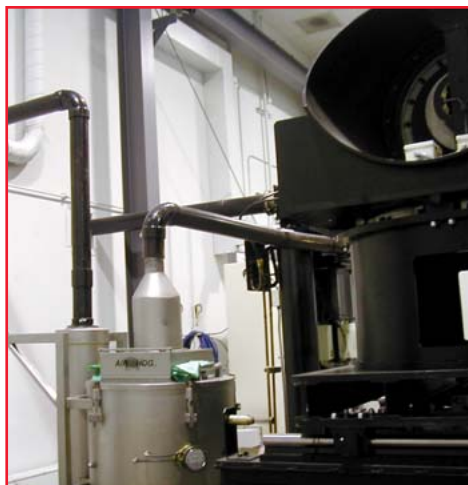
- Reduced labor hours required for decoating.
- Reduced hazardous material use and hazardous waste generation.
- Elimination of disposable personnel protective equipment (PPE).
- Reduced damage to substrates, which increases component life.

LADS decoats three to five mils of paint per pass and currently strips radomes (F-16, C-130 and F-4E/G, and some limited flat panels. The system also has the capability to strip small cylindrical pods for the AQX-14 system. The LADS team has experimented with stripping, landing gear, helicopter rotor blades, ship-board radomes, and cruise missile parts. The strip rate is approximately 220 square feet per hour. From May 1995-August 2004, LADS has decoated 821 F-16 radomes, 264 F-15 radomes, 118 C-130 radomes, and 120 assorted pods. LADS has eliminated over 300,000 gallons of hazardous waste from all the radomes stripped to date. There have been no repetitive worker motion injuries or radomes lost from damaged substrates since LADS has been operational. Historically, twelve (12) radomes per year were lost due to substrate damage from chemical stripping.

The research & development (R&D) for the LADS was started in 1989 and the technology was transitioned into production at OO-ALC in May 1995. At transition, the technology contained mostly unique components and the future follow on maintenance and support wasn't a greatly considered factor. For example, when OO-ALC began to upgrade the LADS facility, reverse engineering was required to develop a complete set of system drawings, due to corporate knowledge loss from the initial contractors and proprietary nature of the technical aspects of the laser.

Since 2001, OO-ALC has had a new facility focus on the LADS, where operational time is the driving metric. Some of the specific actions taken to enhance maintenance and support of the LADS production facility include the following:

- Developing and maintaining complete system drawings.
- Documenting assembly/disassembly procedures.
- Defining and stocking critical components.
- Defining and implementing a Preventative Maintenance Program.
- Solving all system failures with COTS available components, where possible.
- Defining and implementing potential system upgrades to enhance system capability, reliability, and maintainability.





Through this new facility approach, LADS has 95% COTS components and 5% that are unique components. The unique components, which cost greater than \$2,500 and take longer than a week to obtain, have all been purchased. Some of the successes with the COTS insertion include replacing a special order wrap and fill type capacitor with COTS ceramic capacitor. This has increased reliability and reduced the cost per capacitor from \$70 to \$3. Additionally, a modified electrode manufacturing process has reduced the cost from \$70,000 to \$30,000. These improvements to the maintenance and support process have increased the production capable time of the LADS Facility to over 80+ and also opened up capacity for additional use.

OO-ALC is considering to further expand its laser decoating capability by using the LADS technology on other parts, such as, wing surfaces, aileron, flaps, flat panels composite materials, etc. The new effort has an operational plan to include four more lasers, probably of the CO₂ type, and two handheld lasers. The future effort could result in a 6-10 times faster throughput than the current LADS facility and an uptime of over 95%. This expanded facility would be an alternative to bead blasting that is currently being conducted at OO-ALC.

Cadmium plating has been proven to inhibit corrosion of high strength steel parts used in a wide range of Department of Defense (DoD) weapon systems. However, cadmium is a carcinogen, a teratogen, and a toxic metal that can readily be leached causing potential contamination of the ground water supply and food chain. These environmental and health related concerns are further

teristics. Proposed replacements for cadmium must, therefore, not only match or surpass its current performance, production throughput, maintainability, reparability, and cost, but

A Background on Cadmium Alternatives

aggravated by the common use of sodium cyanide as part of the plating process in the manufacturing plant and the use of hexavalent chromium-based post-treatments, which pose serious worker safety concerns.

Cadmium has been widely accepted as the coating of choice on high strength steel applications (i.e., landing gear, rotor shafts, pneumatic/hydraulic actuator rods and cylinders, aircraft engine attach points, thrust pins, torsion links, locks, fasteners, etc.) due to its excellent adhesion, corrosion resistance, and proper lubricity charac-



also guarantee elimination of the current cadmium related waste streams without generating another Environmental, Safety, and Occupational Health (ESOH)-regulated hazardous waste stream.

Several technologies pertinent to coating high strength steels have emerged to address this challenge. These include the use of electroplated of Zn-Ni and Sn-Zn from aqueous plating baths, metal-filled polymer composites, novel stainless steel alloys, and electroplated aluminum from an organic plating bath, as well as ion vapor deposited (IVD) aluminum.

The simplest approach to cadmium replacement appears to be aluminum. It is environmentally clean, non-toxic, and safe to handle and use by workers. These environmental qualities eliminate some life cycle costs, such as waste collection, storage, and disposal, associated with the processing of hazardous materials. Acid salt fog, neutral salt fog, and outdoor exposure tests have demonstrated

unequivocally that aluminum coatings provide equal or superior corrosion protection to cadmium-plated steel parts. Aluminum coatings offer additional advantages. They can be subjected to temperatures as high as 925 °F, while cadmium is limited to 450 °F. They may be exposed to fuels with no adverse effects and be used in space applications, while cadmium sublimates in a vacuum environment and plates out on neighboring surfaces.

Aluminum coatings have been produced on high strength steel parts by either electroplating or IVD. The plating process, known as Alumiplate®, requires the use of a toluene-based solution. The deposition takes place in an enclosed,

oxygen- and water-free environment where the parts to be coated are introduced through a load-lock system. No hydrogen is generated and, therefore, no post baking is required to mitigate hydrogen embrittlement. Although the coatings produced by this process appear to have excellent corrosion resistance properties, several shortcomings are evident, namely: (1) the process uses hazardous and toxic chemicals, and is unlikely to be implemented at DoD depots, logistics centers, or OEM facilities; (2) the technology is proprietary and controlled by a small business with only one processing site; and (3) the part geometries and sizes that can be coated are limited by the plating bath size.

The IVD process takes place in an evacuated chamber where aluminum is evaporated onto a substrate being simultaneously subjected to bombardment by plasma-

By Dr. Eric Brooman, AFRL/MLSC

ionized argon gas. Because the aluminum deposition takes place in vacuum and no hydrogen is generated, a hydrogen embrittlement relief bake is not necessary. However, despite this advantage, the IVD aluminum process exhibits several limitations:

- The IVD growth mechanism results in the formation of columnar grains that provide a conduit for oxygen and corrosive agents to readily diffuse through the grain boundaries and attack the underlying substrate. Although increasing the coating thickness and peening may minimize this problem, it can be eliminated by forming, if

possible, a randomly oriented grain structure.

- The fact that an evacuated chamber is required to produce the coatings severely limits the throughput and results in a higher cost per coated part as compared to continuously operated atmospheric processes. Furthermore, the IVD process, being partly a line-of-sight deposition technique, often necessitates two coatings per cycle to achieve acceptable coating thickness uniformity. After the application of the first coating, the system is vented, the parts manually rotated, and the deposition process re-started. Thus, both chamber size and processing times limit the utility of IVD.
- In addition to throughput and cost considerations, the IVD process has proved to be unable to coat non-line-of-sight components/parts/surfaces. Typical IVD "throwing power" (or conformal step coverage) allows for functional aluminum coatings to be deposited in a cylinder to a depth equivalent to one time its diameter. In view of the fact that a large percentage of parts requiring corrosion protection have inside diameters, blind holes, and complex geometric surfaces, there is a need to resolve this coating conformability issue.
- IVD aluminum, as well as all other sacrificial coatings, rely on hexavalent chromium containing post treatments for optimum corrosion protection and paint adhesion. Therefore, although cadmium is eliminated from the coating system life cycle, hexavalent chromium is still present for all alternatives.

AFRL Investigates Novel Technology as a Replacement for Cadmium

Air Force Research Laboratory (AFRL) has been awarded a contract through the Strategic Environmental Research & Development Program (SERDP) to evaluate, optimize, and demonstrate a novel chemical vapor deposition technique to deposit aluminum coatings under atmospheric pressure conditions. This three-year proposed program represents a collaborative effort involving a team of government, academic and industrial personnel well qualified in coating development and evaluation, and with a strong interest in pollution prevention in the defense industrial base. This Team is comprised of:

- Maj. Timothy Allmann and Dr. Eric Brooman at the Air Force Research Laboratory, Wright Patterson Air Force Base (AFRL/MLSC),
- Prof. Roland Levy at the New Jersey Institute of Technology (NJIT),

This article was
submitted by
Dr. Eric Brooman,
AFRL/MLSC.

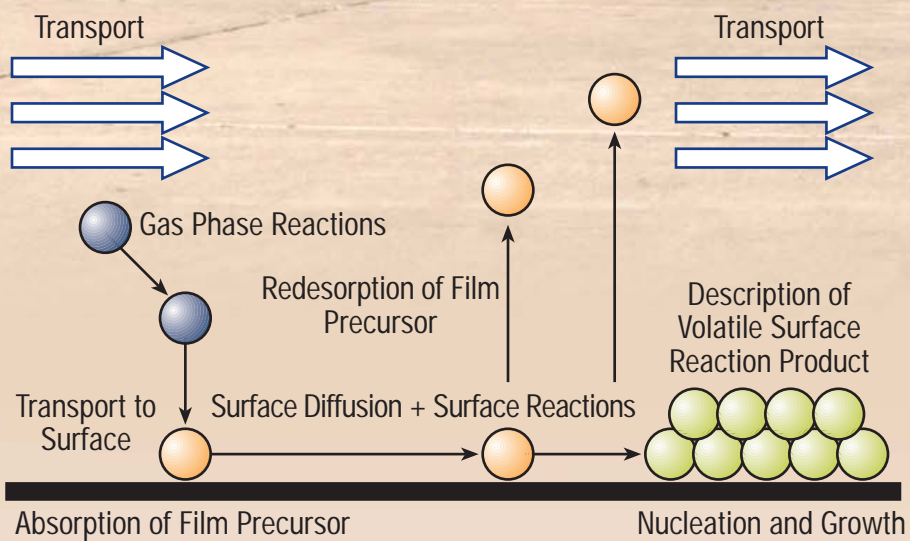
- Mr. Craig Matzdorf at the Naval Air Systems Command (NAVAIR),
- Dr. John Beatty and Mr. Brian Placzankis at the Army Research Laboratory (ARL), and
- Mr. Steven Gaydos of the Boeing Company.

The AFRL Team will manage and lead this effort with testing for mechanical properties, corrosion resistance, and hydrogen embrittlement of the aluminum coatings performed at NJIT, NAVAIR, and ARL facilities. Boeing will provide input about military and commercial aircraft requirements and commercialization issues, which will facilitate and expedite subsequent technology implementation.

This program will investigate the use of atmospheric pressure chemical vapor deposition (APCVD) to

produce high quality aluminum coatings for corrosion protection of high strength steels. In addition to offering an environmentally benign alternative to cadmium plating, this process promises to provide high production throughput, low cost, conformal step coverage, and coatings with desirable properties and performance. In addition, the process will be amenable for use at DoD depots, original equipment manufacturers (OEMs) and subcontractor facilities, and air logistics centers. The program also will evaluate hexavalent chromium-free post treatments to provide a total coating system. Elimination of hexavalent chromium will enable the coating system to be totally environmentally compliant over its life cycle.

For more information, please contact Major Allmann or Dr. Brooman (AFRL/MLSC).



Fundamental Steps of CVD Process

Overview of the Chemical Vapor Deposition (CVD) Process

MS90353 blind fasteners used in the F-16 inlet are now coated with Ion Vapor Deposited (IVD) aluminum to minimize workers' exposure to cadmium dust while sanding primer in the inlet during the manufacturing process at Air Force Plant 4, Lockheed Martin, Fort Worth, TX.

of the forward portion of the F-16 inlet were MS90353 high-strength blind fasteners, a pull-type non-threaded rivet. The risk assessment gave the aluminum and ceramic technology significantly lower risk scores than the other candidates. Although aluminum does not have the lubricity by itself that is required for threaded fasteners applications, it appeared ideal for the MS90353 fastener application. Additionally, there was already an

aluminum coating option on the MS90353 specification.

Since implementation of the IVD aluminum-coated fasteners, air monitoring of the forward inlet sanding procedure has revealed a drastic reduction in the generated cadmium dust. However, the presence of cadmium plating on other fasteners in the center portion of the inlet, particularly threaded bolts, is still a challenge. The follow-

IVD Aluminum Coated Fasteners on the F-16 Inlet to Improve Worker Health and Safety

This project was part of a five-year program, funded by the F-16 System Program Office (SPO), to minimize the use of hazardous materials during production. In 2003, Air Force Plant 4 funded a follow-on project to qualify alternatives to other cadmium-coated fasteners used in the inlet to reduce the cost and risk from worker exposure to cadmium dust.

As a part of a larger cadmium replacement program, funded by the F-16 SPO, project engineers conducted an assessment of available cadmium alternatives and then performed a risk assessment on several candidates including aluminum coating, zinc-nickel plating, tin-zinc plating, and ceramic coatings. The risk assessment methodology used severity and probability parameters in a matrix to determine an overall material risk. The engineers also analyzed the drawings for the F-16 inlet to identify the configuration and coating system of the existing fasteners.

Analysis of the inlet drawings revealed that approximately 90% of the fasteners on the inner surfaces



on project will determine where the remaining cadmium fasteners are in the inlet and will attempt to replace them with a cadmium-free alternative. This effort includes working with the Joint Group on Pollution Prevention and with fastener vendors to incorporate a new coating, plating, or substrate. Compatibility testing of the new coating to ensure no detrimental effect on function, strength, or durability will also be conducted.

The F-16 program will benefit from this project due to the reduced exposure to cadmium in the inlet during production, maintenance, and repair activities. Also, aircraft disposition at end of service or in case of a crash would be improved by a reduction in cadmium-plated parts. This benefit presents a strong case for decreased life cycle cost. Other weapon systems would benefit as well from the qualification of cadmium-free fasteners.

This research was conducted by Ms. Mary Wyderski of the F-16 System Program Office, Mr. Ali Khan, Air Force Plant 4, and Mr. Jerry Brown, Lockheed Martin Aeronautics.

The success of the sputtercoat technology, a dry vacuum chamber process, has created further interest to move toward a sputtered aluminum process that can be applied not only to exterior surfaces, but also interior surfaces of various aircraft components.

Aeronautical Systems Center, Pollution Prevention Division's (ASC/ENVV's) Ion Vapor Deposited (IVD) Sputtercoat project, championed by Charles R. Valley, Senior Environmental Scientist, was successfully completed at Hill AFB in 2003. Even before the project was completed, it had sparked a lot of interest at the three Air Force depots that were aware of, or participating in the demonstration/validation.

The success of the sputtercoat technology, a dry vacuum chamber process, has created further interest to move toward a sputtered aluminum process that can be applied not only to exterior surfaces, but also interior surfaces of various air-

vailing thought is why not introduce a replacement process that can do more, and is more responsive to the depots' coating needs?

Currently, Valley is working with AFRL/MLSC and AFMC/LGPE as a partner in a multi-depot project that will develop and qualify a flexible replacement coating system. This multi-phased effort has been funded. It will address the depot's coating needs and expand on the successes of Valley's earlier Sputtercoat project. The first two phases will focus on evaluating and optimizing the sputtering technology as a cadmium replacement and then developing a technology insertion plan. In addition, the opportunity to replace some hard chromium coatings also will be explored. Once these activities—led by Tom Naguy and Dr. Eric Brooman of the Pollution

IVD Sputtercoat Project Update

craft components. Current IVD Coaters are limited to exterior surfaces. Also, many IVD Coaters used at the depots are old and have maintenance issues, which create downtime for aircraft parts requiring recoating. New replacement IVD coaters are desired, so the pre-

vention R&D Team in AFRL/MLSC—have been completed, the responsibilities for scaling up and implementing the sputtering technology at the depots will be handed over to Chuck Valley at ASC/ENVV. AFRL/MLSC will continue to provide technology support, as needed.



This article was prepared by Mr. Chuck Valley, ASC/ENVV and Dr. Eric Brooman (AFRL/MLSC).

Two F-16s, stationed at Spangdahlem AB, Germany, were coated with environmentally improved coatings and had their first inspection of the coatings in October 2004.

Air Force Plant (AFP) 4, manufacturing site of the F-16, is subject to Title V Permitting. As such, the facility continually strives to reduce its volatile

Significant Improvements in Environmental Impact of F-16 Coatings: Field Service Evaluations Being Conducted

organic compounds (VOC) and hazardous air pollutant (HAP) emissions. In keeping with this goal, ASC/YPVE initiated two pollution prevention projects to reduce the VOC and HAP content of coatings used on the F-16 while maintaining or enhancing current performance levels. One project developed a more environmentally friendly topcoat, while the other developed a lower VOC/HAP content material for the F-16 weapon system.

Two topcoats were selected during development for use in the field service evaluation (FSE): CAAP ZVOC Topcoat contains 50 grams per liter VOCs and Deft LVOC Topcoat contains 92 grams per liter VOCs. Both coatings are a significant environmental improvement over the current topcoat, which has approximately 420 grams per liter of VOCs. Both coatings are now HAPs free as well. In addition to the environmental improvements, both topcoats have shown a 25% weight savings, and the CAAP coating has the potential for 14% cost savings while the Deft coating has the potential for 60% cost savings over the current specialty topcoat. Both topcoats are applied using existing spray systems.

Two FSE aircraft were treated at Hill AFB with the lower VOC/HAP material along with one of the two new topcoats during March and April of 2004. The aircraft were returned to Spangdahlem AB, Germany in May 2004.

During the application at Hill AFB, feedback was positive for both the topcoat and the lower VOC/HAP material, confirming that use of these improved coatings would also significantly benefit the depot.

**CAAP ZVOC Topcoat
contains 50 grams
per liter VOCs and
Deft LVOC Topcoat**

**contains 92 grams
per liter VOCs. Both
coatings are a signifi-
cant environmental
improvement over the
current topcoat, which
has approximately
420 grams per liter
of VOCs.**

**...both topcoats have
shown a 25% weight
savings, and the CAAP
coating has the poten-
tial for 14% cost sav-
ings while the Deft
coating has the poten-
tial for 60% cost sav-
ings over the current
specialty topcoat.**

Field inspections for the FSE will be scheduled at 6-month intervals with the first one conducted in October 2004. Preliminary reports from Spangdahlem indicate that the new topcoat is an improvement over the current coating and has shown no peeling or cracking to this point. A final inspection will be conducted at the conclusion of the 18-month FSE interval, and a final report will document the results.

Ms. Mary Wyderski is the Air Force Program Manager for this effort and Mr. Randall Reed of LM Aero is the principal investigator.

Three Turco Products Given Conditional Approval to Chemically Strip Fragile Aircraft Surfaces at AFP 6

Three Turco Products have been incorporated in LM Aero-Marietta Process Specification STP59-008 and conditional approval has been given to use these materials to chemically strip fragile aircraft surfaces during the manufacturing process for the C-130J at Air Force Plant (AFP) 6. This two-year project was funded by Aeronautical Systems Center, Pollution Prevention Branch (ASC/ENVV) and completed by Lockheed Martin Aeronautics, Marietta, GA in December 2003.

Under this effort, LM Aero identified available environmentally acceptable chemical strippers and developed a test plan for validating the new strippers to industry and military requirements. The criteria used to validate the new strippers included that any new stripper must be effective in removing typical aircraft exterior paint systems, safe on all metallic surfaces of an aircraft, can be used on fragile control surfaces without damage, an alternative to mechanical methods, and not time consuming and labor intensive.

The test plan included the following thirteen test requirements: paint stripping efficiency; viscosity; flow; single immersion corrosion; acrylic stress crazing; sandwich corrosion; dissimilar metal corrosion; hydrogen embrittlement; storage stability; re-paintability; rinsability; pH; and effect of polysulfide sealants. Eleven candidates, including Ardrox 2865 (which was used as a control) were selected for testing over a two phase cycle.

Only five of the thirteen materials passed the stripping efficiency test. The paint stripping efficiency test measured the strippability, rinsability, and refinishing properties of the different materials on the two common paint systems. For this test, the stripper was applied to the paint system with a 120-minute dwell time, the remover was then

lightly agitated with a nylon brush and the percentage of coating removal was recorded. The procedure was repeated with a 60-minute dwell time (30 minute for the poly topcoat system) for a maximum of 10 cycles. None of the thirteen candidates passed the acrylic stress craze test.

The control, Ardrox 2865 required 13 applications to strip and corroded both cadmium and titanium substrates. Turco 6813ED only took one application to strip (60-120 minutes). However, the anodize deterioration and titanium etch for extended dwell time may cause hydrogen embrittlement. Turco 6840S was applied three times and anodizing deterioration was observed for extended dwell time. The material corrodes cadmium plating and may cause hydrogen

Typical Aircraft Exterior Paint Systems	
System I	System II
Waterborne Epoxy Primer (MIL-PRF-85582, Type 1, Class C2)	High Solids Epoxy Primer (MIL-PRF-23377, Type 1, Class C)
High Solids Epoxy Enamel Topcoat (MIL-PRF-22750)	High Solids Polyurethane Topcoat (MIL-PRF-85285, Type 1, Class H)

Two Typical Aircraft Exterior Paint Systems Used as a Criteria for Validating New Strippers

embrittlement. Turco 6881 was applied once. Again deterioration was observed for extended dwell time, the material corroded cadmium and titanium, and may cause hydrogen embrittlement. D-Zolve GL 15-33 was applied once but results were invalidated since the vendor reformulated the product

Based on the results, Turco 6813 ED, Turco 6840S, and Turco 6881 were given conditional approval for use on the C-130J. Turco 6813 ED was approved for use on all metals except high strength steels with a caution when used on titanium or anodized aluminum surfaces. Turco 6840S and Turco 6881 were given limited approval. Turco 6840S cannot be used on cadmium plated or magnesium surfaces and cau-

**Based on
the results, Turco 6813
ED, Turco 6840S, and
Turco 6881 were given
conditional approval for
use on the C-130J.**

tion must be used when applied on titanium or anodized aluminum surfaces. Turco 6881 cannot be used on titanium, cadmium plated, or magnesium surfaces, and caution must be used when applied on anodized aluminum surfaces. These products have been listed in the LM Aero-Marietta Qualified Products List (QPL) under EPS numbers G32.2357, G32.2358 and G32.236. Additionally, the products and associated information are being incorporated into LM Aero-Marietta Process Specification STP59-008.

Mr. Dave Maddox, Air Force Plant 6 served as the AF Project Manager for this effort and Mr. Frank Ead, LM Aero, Marietta, GA was the primary investigator.

WR-ALC Evaluates Potential Alternatives to MARSOL for the Integral Fuel Tank Cleaning Process

SkyKleen 1000, DS-108, and Sky Wash have been identified as potential alternatives to Marsol for the C-141B integral fuel tank cleaning process under the Warner Robins Air Logistics Center's (WR-ALC's) Toxic Release Inventory Alternatives Development (TRIAD) Program.

These alternatives met most of the acceptance requirements for the

integral fuel tank cleaning process; however, they are not considered as drop-in replacements. Since the C-141B is now undergoing decommissioning, future testing will demonstrate/validate these alternatives for the C-130 fuel integral fuel tank cleaning process.

Under the TRIAD Program, a baseline assessment of the process is conducted to identify the requirements. Then, previous testing efforts with a similar project objective are evaluated to identify drop-

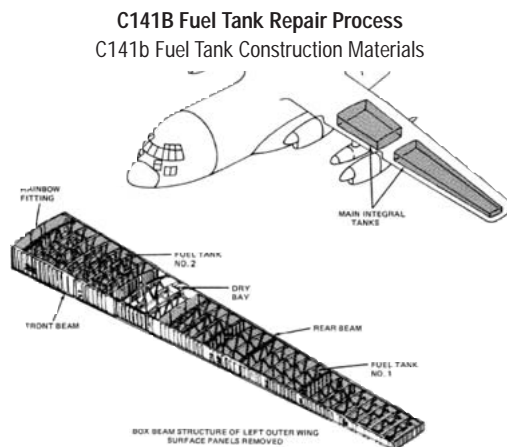
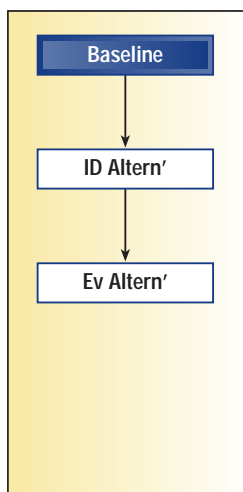
in replacements and alternatives that meet the determined acceptance criteria. If a drop-in replacement is found, an Air Force (AF) 252 form is prepared for the Technical Order (TO) change. Where a drop in replacement is not found, potential alternatives are identified and a test protocol is developed and executed to demonstrate/validate an alternative. Under both scenarios, after the TO is changed, implementation plans are developed to ensure full transition of the alternative(s).

The C-141B Integral Fuel Tank Cleaning Project was executed under a modified version (as shown by the dotted lines in the diagram) of the TRIAD Methodology. The potential alternatives were already known from previous efforts conducted by the contractor. The focus of the project was therefore to determine if the available data met the acceptance criteria for the TO change or if further testing was needed.

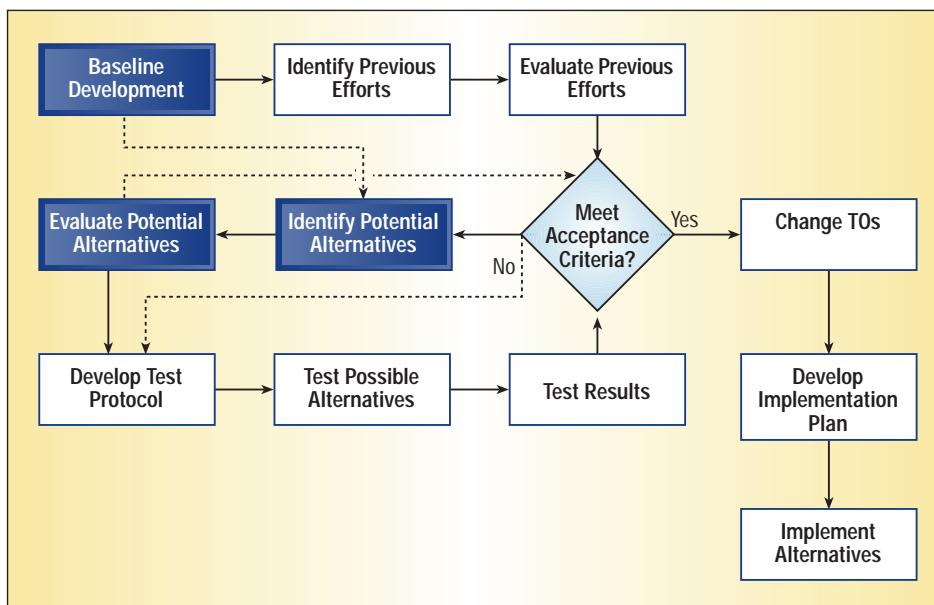
As a part of the baseline assessment, researchers defined the Environmental, Safety, and Occupational Health (ESOH) and performance acceptance criteria. Establishing the ESOH criteria helps select alternatives that meet the objectives of pollution prevention (P2) projects. For this project, one of the most significant ESOH requirements was finding products that contain no hazardous air pollutants (HAPs) or Toxic Release Inventory (TRI) chemicals. Other ESOH criteria included the Aerospace NESHAP requirements for hydrocarbon based solvent and aqueous cleaners, the exposure limit, the flash point, and the Low Explosive Limit (LEL)/Upper Explosive Limit (UEL). The performance criteria were developed with and reviewed by the C-141 System Program Office (SPO) engineer.

Potential alternatives for the C-141B integral fuel tank cleaning included SkyKleen 1000, DS-108, and Sky Wash. The main data sources used for assessment of the three alternatives included the following:

- SkyKleen 1000 - TRIAD Aerospace NESHAP Hand-Wipe Cleaning Project.
- DS-108 - Lockheed Martin Study conducted on DS-108 to find an alternative to TCA on the C-130 tank.



Future Testing for Alternatives to Marsol Will Focus on the C-130 Integral Fuel Tank Cleaning Process



General TRIAD Methodology and the Streamlines Version (Dotted Lines) Used for the C-141b Integral Fuel Tank Cleaning Project

Alternative Fuel Tank Cleaners							
Product/Constituent	HAP	TRI	% (Weight or Volume)	OSHA PEL TLV	LEL/VEL (%)	Vapor Pressure (mmHg)	Rash Point
ESOH criteria	No	No	N/A	Marsol	Marsol	7 for HC Solvents	Marsol
Marsol					1.9/12.6	53.85@68°F	15.8°F
Isopropanol	No	Yes	10	400			TCC
Aromatic 100	No	No	50	Unknown			
MEK	Yes	Yes	20	200			
Ethyl acetate	No	No	20	400			
Skykleen 1000					NA	0.06@68°F	216°F
Dimethyl glutarate	No	No	55-75	Not Est.			TCC
Dimethyl succinate	No	No	15-35	Not Est.			
Dimethyl adipate	No	No	5-25	Not Est.			
DS-108					1.5/11.0	1.1@68°F	115°F
Ethyl lactate	No	No	60-75	Not Est.			TCC
Petroleum distillate, aliphatic	No	No	10-30	500			
Propylene Glycol n-propyl ether	No	No	10-20	Not Est.			
Sky Wash				Not Est.	17.5@68°F	None	
Dowanol	No	No	<1	100			
Water	No	No	>80	Not Est.			

ESOH Criteria Matrix for Three Alternatives and Marsol

Summary of Performance Testing Completed					
<div>Baseline</div> <div>ID Altern'</div> <div>Ev Altern'</div> <p>Note: ✓ indicates that the test was performed by the TRIAD initiative or other institutes.</p>	Recommended Test	SkyKleen 1000	DS-108	Sky Wash	
	Cleaning Efficiency	✓		✓	
	Peel Strength Test	✓	✓	✓	
	Hydrogen Embrittlement	✓	✓		
	Total Immersion Corrosion		✓		
	Low-Embrittling Cadmium Plate Corrosion		✓		
	Effects on Unpainted Metal Surfaces	✓		✓	
	Sandwich Corrosion				
	Effect on Painted Surface	✓	✓		
	Hot Dip Galvanizing Corrosion				
	Effect on Polysulfide Sealants	✓	✓		

Performance Matrix of Testing Available for Three Alternatives

- Sky Wash - The Defense Evaluation and Research Agency (DERA) and the Rolls Royce Study.

A matrix was prepared to compare the ESOH criteria of the three alter-

natives to Marsol (see [page 24](#)). A second matrix of the completed performance testing for the three alternatives was also prepared. This table (see above) shows that not all of the tests required by the

performance criteria were performed; therefore, SkyKleen 1000, DS-108, and Sky Wash were not drop-in replacements. Yet they were still considered potential alternatives to Marsol since none of these products failed any performance requirement. Therefore, developing a test protocol that will provide data to fill the gaps as shown in the table was proposed.

Since the C-141B is now undergoing decommissioning, future test protocol efforts will focus on the C-130 integral fuel cleaning tank process and will continue to use the TRIAD Methodology through implementation of a potential alternative.

Mr. Dave Bury, WR-ALC/EM is the AF Program Manager for this project and Dr. Young Han, Earth Tech Inc. is the primary investigator.

AFRL Leads Project to Scale Up an Environmentally Friendly Non Destructive Inspection for Corrosion Through Coatings

Air Force Research Laboratory (AFRL) is leading an Environmental Security Technology Certification Program (ESTCP) project to demonstrate/validate the reliability of an Infrared-Reflectance Non-Destructive Inspection (IR2NDI) technique to

detect corrosion under typical aircraft and ground system coatings. The IR2NDI technique was developed under a Strategic Environmental Research & Development Program (SERDP) project. An advanced IR spectral imaging camera system will be employed in

this ESTCP Project. This system will be used to demonstrate/validate the collection of reliable data, while establishing cost and environmental benefits. Expected DOD environmental benefits include an estimated reduction of 50,400 lbs of volatile organic compounds (VOC) per year and a reduction of 720 lbs per year of carcinogenic chromates, when fully implemented

This article was submitted by Mr. John Speers, AFLR/MLSC and has been edited from an ESTCP Fact Sheet.

with an extended life topcoat system on a cargo aircraft. This assumes a fleet of 180 aircraft, and that the coating life is extended by just one year, from a five-year de-paint/paint cycle to a six-year cycle, with 36 aircraft per year being processed.

The IR2NDI technique takes advantage of an optically transparent spectral band, or window, in most coating systems, within the Mid-IR range of the electromagnetic spectrum. Since corroded surfaces do not reflect IR energy as well as the non-corroded surfaces, the corrosion signal is suppressed for the corroded surfaces or areas, resulting in a readily discernable and detectable dark area on a monitor or LCD screen. The camera system (hardware and software) will be optimized and performance boundaries established with feedback from both laboratory and field measurements. Spectral analysis of actual service coating systems will be made to identify compatibility with camera configurations with pre-corroded laboratory standard specimens. Field measurements will also be made prior to stripping assemblies and parts so as to establish and validate the IR2NDI technique under actual field conditions.

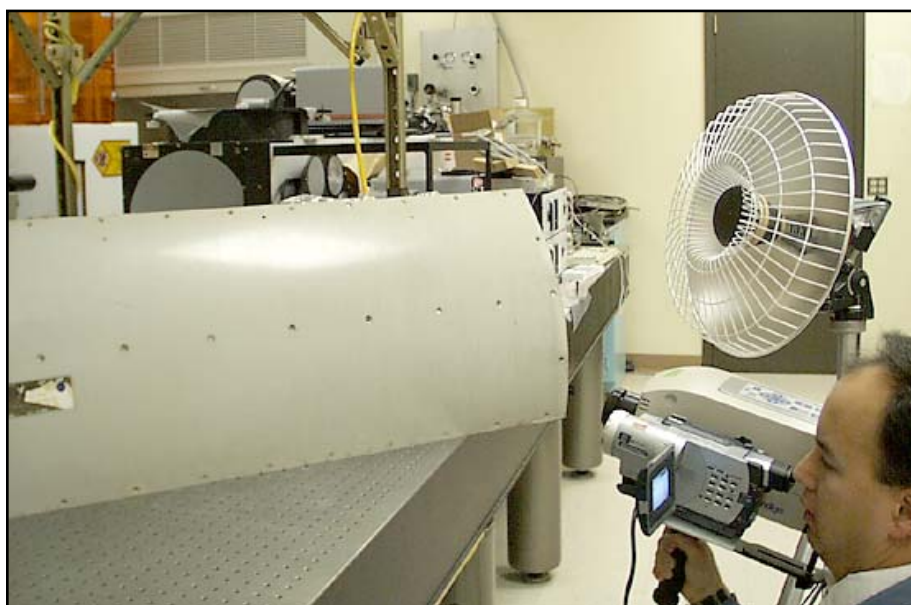
The IR2NDI technique to be demonstrated will be able to target and map specific areas that require maintenance due to corrosion, allowing for a migration from schedule-based to condition-based maintenance. This technology will significantly reduce pollution and costs by eliminating unnecessary coating stripping/recoating. The demonstration/validation will establish and prove the technology and the cost/waste reductions in depot and field maintenance operations. After successfully demonstrating this new technology, depot

IR2NDI Program Participants

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 John ThomsConcurrent Technologies Corp Cost/Benefit Analysis PM
 John SpeersProgram Support to AF/ESTCP
 Jack BenferNavy Dem/Val Lead
 Don SkeltonArmy Dem/Val Lead
 Rusty Waldrop.....Coast Guard Lead
 Technology AdvisoryNDI/Corrosion/Coatings/Structures Experience Board (TAB) Personnel
 Various Weapons Systems Users/Program Offices

and field maintenance personnel will have an additional method to inspect for corrosion while minimizing the removal of coating systems.

For further information about this project, please contact, Mr. Joseph Leone, AFRL/MLSA.



Weapon System P2 Champions

Monitor Contributors: 1998-Present

"I can see so far
because I've stood
on the shoulders
of Giants."

	Carol Manda	AFMC/MSEVO (CTC)
	Karen Marshall	
	David Martin	AFMC/MSEVO
	Phil Martin	AFCEE
	Craig Matzdorf	NAWCAD
	Heidi Maupin	Navy
	Laura Maxwell	AFCEE/EQ
	Bob McAllister	
	Ron McAtee	
	Tad McCall	
	Brian McCarty	
	Margaret McGhee	
	Darrell McKinley	Lockheed Martin
Capt	Laura McWhirter	Retired
	Debbie Meredith	AFMC/LGP
	Marriane Miclat	SAF/PA
	Frank Miller	SAIC
	Susan Misra	AFMC/LGPE
	Fred Missel	Boeing
	Jerry Mongelli	AFMC/LGPE (CTC)
	Lee Monroe	
LtCol	Gil Montoya	ASC/ENNV (Retired)
	Ralph Mowery	Army
	Tom Naguy	AFRL/MLSC
	Carlos Nazario	OC-ALC/EM (Regrettably Deceased)
Col	George New	Retired
	Drek Newton	Navy
	Robert O'Brien	AFIERA/RSEQ
	Kevin O'Connor	
	John Ogg	AFMC/EN
	Ray Olffy	AFMC/DRA (Retired)
	Rick Osterman	Northrop Grumman
	Kristen Osterman	
	Chuck Parmele	SAIC
	David Patrick	Sciences International, Inc.
	Chuck Pellerin	SERDP/ESTCP
	Peter Pembleton	
	Stephen Perez	DSCR
	Andrew Pfifer	Dacromet
	Tony Phillips	Lockheed Martin
	Doug Piner	MCB Camp Lejeune
	Sydney Pope	DCMC
	Tim Provens	AFRL
	Jim Reese	WR-ALC/EM
	Luke Reyher	SAIC

	Michael Riley	Surface Treatment Technologies, Inc.
	Milt Rindahl	AFMC/MSEVO (Retired)
	Margy Roeck	ESC/FM
	Bill Rosenthal	Lockheed Martin
	Glynn Rountree	
	H.E. Rowland	Defense Supply Center
	Sam Rupe	
	Lori Sargeant	AFMC/LGPE (CTC)
	Bruce Sartwell	Naval Research Lab (Battelle)
	Tami Savage	SAIC
	Ron Scharven	AFMC/PA
Capt	Chad Schroeder	ASC/LPZ
	Joe Schultheis	ASC/ENNV (SAIC)
	Jared Scott	ASC/YFAI
	Ed Seaman	TRW
	Jay Shah	AF/ILEVO
	Shashi Sharma	AFRL/MLBT
	Debbie Shaw	AFRL/ML
	Craig Shaw	OO-ALC
	Richard Slife	WR-ALC/MAPE
	Mary Lou Slows	
	Edgar Smith	Army
	Ed Snyder	AFRL/MLBT
	Sandy Snyder	
	Eric Sorrells	Army
	Julia Sowash	SAIC
	John Speers	AFRL/MLSC
	Mary Spencer	AFFTC/EM
	Mike Spicer	AF CTIO
	Dan Spiegelberg	CSC

	Tom Spittler	AFMC/LGPE
	John Stallings	ASC/GR
	Eric Stevens	AFIOH
	Mike Stock	AETC LG/LG-EM
SMSgt	Greg Stonelake	
	Randy Straw	AFRL/MLSC(CTC)
	Don Streeter	ASC/ENNV
	Tim Sumpter	AFRL/MLSC (SAIC)
Major	Darryl Sumrall	AFMSA/SGPE
	Mike Surratt	SAIC
	Stefan Susta	EMTEC
	Mary Swinford	ASC/LPN (PEWG)
	Emily Sylvester	
	Don Tarazano	ASC/ENNV (SAIC)
Dr.	Christopher Taylor	AFCEE
	Dennis Teefy	Army
	Lasandra Teeters	NAS Pax
	George Terrell	AMC
	Sheldon Toepke	Boeing (Retired)
	Heather Travis	SAIC
	Lisa Trembly	Navy
	Larry Triplett	Boeing
	Johnny Tsiao	OC-ALC
Capt	Lance Turner	AETC/CEE
	Cliff Turner	ASC/ENSA
	John Ursillo	
Capt	Lowell Usrey	AFCEE
	Martha Vaillancourt	ASC/ENNV
	Chuck Valley	ASC/ENNV
	Noel Van Hoesen	
	Libby Van Hook	AFMC/PA
	Beth Viar	
	John Vidic	AFFTC/EM
	Amy Vince	ASC/RAE
	Jim Voytko	CTC
	Steve Vukson	AFRL/PRPB
Major	Andy Wallen	SAF/FM
	Yvonne Watson	
	Marja Weaver	AFMC/MSEVO
	Flint Webb	SAIC
	Neal Werner	Pall
	Gary Whitfield	NADEP
	Dick Whitney	ASC/ENV (Retired)
	Barbara Williams	AFCEE
	Linda Willis	AFMC/LGPE
Major	Don Woike	ASC/ENNV
	Bob Wolf	Lockheed Martin
	Gwen Woods	
	Mary Wyderski	ASC/YPVE
	Don Yates	ASC/ENV (Regrettably Deceased)

Monitoring Solutions to Sustain the Warfighter

Aeronautical Systems Center (ASC/ENVV)
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An advanced infrared spectral imaging camera system is being demonstrated/validated for non-destructive inspection for corrosion through coatings.



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IVD aluminum fasteners at the F-16 inlet minimize exposure to cadmium during production at AFP4.



LADS facility at OO-ALC-A P2 success story.